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ABSTRACT

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TWO TYPES OF LEARNING IN A BUSINESS SIMULATION

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INTRODUCTORY STATEMENT

The Center for Social Organization of Schools has two primary objectives: to develop a scientific knowledge of how schools affect their students, and to use this knowledge to develop better school practices and organization.

The Center works through five programs to achieve its objectives. The Academic Games program has developed simulation games for use in the classroom, and is studying the processes through which games teach and evaluating the effects of games on student learning. The Social Accounts program is examining how a student's education affects his actual occupational attainment, and how education results in different vocational outcomes for blacks and whites. The Talents and Competencies program is studying the effects of educational experience on a wide range of human talents, competencies, and personal dispositions in order to formulate--and research--important educational goals other than traditional academic achievement. The School Organization program is currently concerned with the effects of student participation in social and educational decision-making, the structure of competition and cooperation, formal reward systems, ability-grouping in schools, effects of school quality, and applications of expectation theory in the schools. The Careers and Curricula program bases its work upon a theory of career development. It has developed a self-administered vocational guidance device to promote vocational development and to foster satisfying curricular decisions for high school, college, and adult populations.

This report, prepared by the Academic Games program, presents the results of a study intended to determine the effectiveness of a business simulation for increasing students' knowledge of business facts and concepts and their ability to evaluate business decisions. The results showed that the simulation increased the students' factual knowledge and possibly also increased their business decision-making ability.

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ABSTRACT

Fourteen high school students, chosen at random from a group of twenty-eight, spent five hours participating in a business simulation, after which all twenty-eight students took tests designed to measure their knowledge of business facts and concepts and their ability to evaluate business decisions. The simulation group outperformed the control group on both tests, but the difference approached statistical significance only for the test of facts and concepts.

INTRODUCTION

A claim frequently made for simulation as a teaching technique is that it teaches the players the cause-and-effect relationships that operate in the situation simulated by the game, thereby improving the players' ability to make and evaluate decisions in that field. A second common claim is that simulations teach facts and concepts which are important in the situation simulated by the game.

At present, the first claim appears to be based more on faith than on research evidence. One reason for the lack of research evidence may be the difficulty of measuring such variables as "learning of relationships" and "decision-making ability." Fletcher and Dobbins (1970) attempted to overcome this difficulty by measuring students' ability to make verbal predictions of the outcomes of situations like those simulated. The predictions were made in discussion groups of three students each. Judges listened to tape recordings of these discussions and scored each prediction on a three-point scale. Comparisons of "average quality per prediction" favored students who had played the simulation game over those who had studied the same situations by reading and discussion, but the difference was caused by a decrease in the scores of the control group, rather than by an increase in the scores of the experimental group. Fletcher and Dobbins concluded that " . . . game experiences do tend to improve the ability of the participants to make predictions, though most impressively with analogous cases, not with the one directly simulated by the game."

The experiment reported here tested learning of relationships and decision-making ability by using a written test which required the student to evaluate a set of decisions made in a hypothetical situation. The responses were scored according to the number of relevant relationships the student cited in making his decision. This technique is similar to that used by Fletcher and Dobbins, in that it requires the student to make correct and relevant predictions. However, it also requires him to see the relevance of these predictions to the decisions he must evaluate. Also, because the tests are taken individually, each student's score is independent of each other student's score (except, of course, for effects created by the experimental treatment).

The second claim examined here--that simulations teach the players factual information about the real situation--is supported by some research which indicates that simulations are about as effective as conventional classroom techniques for teaching factual information.[1] Our experiment included a test of factual information and vocatulary relevant to the situation simulated.

Venture, the simulation game used in this experiment,[2] simulates a consumer-products industry dominated by a small number of large

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[1] See, for example, Anderson (1970) and Wing (1966).

[2] Venture is available from the Proctor & Gamble Company, Director of Educational Services, P.O. Box 599, Cincinnati, Ohio 45201.

companies. Each team represents the top management of one of the large companies. The game covers six half-year periods of simulated time. Each period consists of an "operations meeting" and a "profits meeting." At the operations meeting the players must decide how much to charge for their company's product, how much to produce, whether to allocate funds for depreciation and for market research, and how much to allocate for marketing and advertising and for research and development. At the profits meeting the players allocate their company's profits (after taxes) among dividends to stockholders, investment to reduce costs, investment to increase capacity, investment to improve research and development facilities, and increased operating revenue. As in a real business, there is no single criterion for evaluating performance; each company's sales, profits, and stock price are posted publicly and can all serve as criteria.

METHOD

Subjects

The subjects for this experiment were 28 students--27 seniors and one junior--at Cardinal Gibbons High School, an all-boys Catholic high school in Baltimore. All the subjects were paid volunteers. They were divided at random into an experimental and a control group of 14 students each. The experimental group spent about five hours on a Saturday participating in Venture; the control group received no treatment. The following Monday, the students in both groups were given the tests to fill out at home and hand in to the teacher who helped organize the experiment. The students were paid when they handed in their completed tests.

Procedure

The experimental treatment consisted of a single complete play of Venture directed by the experimenter and a colleague, followed immediately by about a half-hour of discussion led by the experimenter.[1] Others present were the experimenter's wife, who assisted in the scoring, and the teacher who helped organize the experiment; the latter was present only at the beginning and at the end of the session. The session was held in a classroom in the school building and lasted from about 9:00 a.m. to

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[1]Appendix A contains an outline of the post-game discussion.

about 3:00 p.m., with two breaks of about a half-hour each. For the simulation, the players were divided into four teams: two teams of four members and two teams of three members. The simulated industry was identified as the detergent industry, and the teams were given fictional product names for identification: "Wiz," "Snap," "Keen," and "Tuffo."

Measuring Instruments

Included in the Venture materials kit is a "Business Operations Quiz" consisting of ten multiple-choice items.[1] Each item tests the students' knowledge of a particular fact or concept which could be learned from Venture. This quiz was used as the measure of factual information for the experiment.

To measure the student's ability to evaluate business decisions, the experimenter constructed a "situation test" which presented the student with a summary of the major decisions made by a hypothetical company. The student was to evaluate the decisions in a short essay. Although five specific decisions were listed, only three were actually used in scoring the essays.

The students received the two tests stapled together with a cover sheet which read:

> This test is a part of a research study. You will not be graded on it by your teachers at Cardinal Gibbons. It should take you less than 45 minutes to complete.
>
> Please do not discuss this test with anyone until you have finished taking it. Please do not change any answers once you have finished it. If you don't know an answer, please don't look it up or ask someone; just make the best guess you can and go on.

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[1] Appendix B contains a copy of this test.

Answer the Business Operations Quiz first: then go on to the Situation test.

The essays were scored by two scorers who had not participated in any other aspect of the experiment. The scorers were given a model answer and a specific scoring formula to use in scoring the essays.[1] The essays were presented to each scorer in a different random order, and the student's score for the test was the sum of the scores his essay received from the two scorers.

The school also made available to the experimenter a list of the students' verbal ability scores. The verbal ability scores are grade-equivalent scores from the Educational Development Series,[2] taken at grade-level 11.3.

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[1] Appendix C contains a copy of the situation test, the model answer, and the scoring formula.

[2] Published by Scholastic Testing Service, Bensenville, Illinois.

RESULTS

The distributions of scores on the quiz and on the situation test are shown in Table 1 below.

Table 1

Distributions of Scores on
Multiple-Choice Quiz and Situation Test

Multiple-Choice Quiz			Situation Test		
No. of Students With Score of:	Simulation Group	Control Group	No. of Students With Score of:	Simulation Group	Control Group
10	0	0	8	2	1
9	1	1	7	1	0
8	1	1	6	0	0
7	5	2	5	3	0
6	4	2	4	2	2
5	3	2	3	0	3
4	0	2	2	2	3
3	0	2	1	1	4
2	0	2	0	3	1
1	0	0			
0	0	0			
Total Number of Students	14	14	Total Number of Students	14	14
Mean Score	6.50	5.07	Mean Score	3.64	2.50
Standard Deviation of Scores	1.12	2.12	Standard Deviation of Scores	2.77	1.94

The experimental group outperformed the control group on both tests, as predicted. However, the difference between the groups approached statistical significance only for the multiple-choice quiz ($.05 < p < .10$), not for the situation test. Significance was tested by the Mann-Whitney U-test, using a two-tailed test; the values of U were 58 for the quiz and 78.5 for the situation test. The point-biserial correlation between quiz score and experimental treatment was .39, which indicates that the treatment accounted for about 15 percent of the variance in the quiz scores. The correlation between situation test score and experimental treatment was .23; the treatment accounted for only about 5½ percent of the variance in the situation test scores.

The internal consistency of the quiz scores, computed by KR-20 in both groups combined, was .52. The inter-scorer correlation for the situation test was .75; stepped up by the Spearman-Brown formula with $n = 2$, the inter-scorer consistency estimate for the sum of the scores assigned by the two scorers becomes .84. (Note, however, that high inter-scorer consistency is not a sufficient condition for high reliability; an objective test may have very low reliability, but its inter-scorer consistency will always be 1.00.)

The verbal ability scores were collected for use as a control variable. Unfortunately, although the verbal ability scores were almost identical in the two groups (with a mean and standard deviation of 12.44 and .88 for the experimental group as compared with 12.55 and .84 for the control group), the relationship between test scores and verbal ability

was much weaker in the experimental group. The relationship was also much weaker for the situation test than for the multiple-choice quiz. Figure 1 shows these relationships in graphic form; Table 2 shows the correlation coefficients.

Table 2

Intercorrelations of Scores Within Each Group

Correlation of . . .	Simulation Group	Control Group
Quiz with Situation Test	.59	.54
Quiz with Verbal Ability	.58	.69
Situation Test with Verbal Ability	-.02	.53

No verbal ability score was available for one of the students in the control group. Since he scored 8 on the quiz--nearly three points above the mean--his score might have affected the relationship between verbal ability and quiz scores in the control group. However, since this student scored 3 on the situation test--very near the mean of the control group--his score would not have had a large effect on the relationship between verbal ability and situation test scores.

Figure 1

Scatterplots of Multiple-Choice Quiz Scores
And Situation Test Scores by Verbal Ability
(X = Simulation Group; 0 = Control Group)

Multiple-Choice Quiz Score:

	10.0-10.9	11.0-11.9	12.0-12.9	13.0-13.9	14.0-14.9
10					
9				X	0
8			X		
7			XXX0	XX0	
6		XX	00	XX	
5	X	X	X	00	
4		0	0		
3		0		0	
2		0	0		
1					

Verbal Ability

Situation Test Score:

	10.0-10.9	11.0-11.9	12.0-12.9	13.0-13.9	14.0-14.9
8			X	X	0
7			X		
6					
5	X	X	X		
4		X0	X0		
3			0	0	
2			0	XX00	
1		00	0	X0	
0		X	X0	X	

DISCUSSION

The results of the quiz show clearly that the simulation was effective for teaching facts, especially for students of low verbal ability. Students of high verbal ability seemed to know many of the facts that were tested, even without receiving any instruction, while students of low verbal ability learned these facts from the simulation. The results of the situation test show that simulation was also effective for teaching decision-making and knowledge of relationships, but this effect is much weaker. Three of the students in the simulation group failed to mention any of the four specific relationships for which the situation test was scored, even though two of these relationships were mentioned during the post-game discussion.

The most puzzling aspect of these results is the relative strength of the effects on the two different tests. Advocates of simulations for teaching usually emphasize the value of simulations for teaching objectives like those tested in the situation test, rather than for teaching facts. However, the implied comparison is probably between simulations and other methods of teaching, rather than between simulations and no treatment. If the control group in this study had received instruction by conventional classroom techniques, they might have done as well as the simulation group on the quiz, since previous studies have shown simulations and conventional classroom techniques to be about equally effective in teaching facts. This study suggests--tentatively--that a simulation can also be at least partially effective in teaching decision-making and knowledge of relationships. Whether simulations are more effective than conventional classroom methods for achieving these objectives is a question that remains unanswered.

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APPENDIX A

Outline of Post-Game Discussion

In directing the post-game discussion, the experimenter . . .

1. Asked the teams to explain their strategy:

   a. Whether they based decisions on own company's experience or anticipating other companies' strategies.

   b. Whether they thought marketing and advertising was important.

   c. Whether they thought research and development was important.

2. Asked the students whether they would play differently if they were to play the game again.

3. Pointed out that high school students in a business simulation are less predictable than real business executives.

4. Explained that, in the game, sales potential depends on both selling price and marketing expenditures of one's own company and of other companies. (This was in response to a student's question.)

5. Stated that the purpose of the experiment was to find out what the game teaches. (Also in response to a student's question.)

6. Asked the students what they thought they had learned from the game.

7. Asked what they had expected to learn from the game.

8. Asked whether they had enjoyed the game.

9. Requested that the students not discuss the game with other students who had not played it, until all tests had been handed in.

APPENDIX B

Business Operation Quiz

1. The expense incurred by a company as buildings and equipment wear out is called:

   (a) Automation (b) Depreciation (c) Inflation (d) Incapacitation (e) Demurrage

2. Stockholders' dividends are paid from:

   (a) Profits before taxes (b) Profits after taxes
   (c) Operating expenses (d) Working capital
   (e) Plowback funds

3. Plowback--the reinvestment of capital in a business--may be made only with funds taken from:

   (a) Operating expenses (b) Profits before taxes
   (c) Profit after taxes (d) Accounts receivable
   (e) None of the above

4. Among the 500 largest industrial corporations in the U.S., profits after taxes for most of the companies (80%) are likely to be about what per cent of sales income?
   (a) 1-8% (b) 11-18% (c) 21-28% (d) 33-41%
   (e) 48-55%

5. Profits are never used for:

   (a) Investments (b) Management salaries (c) Stockholders' dividends
   (d) Increasing production (e) Developing better products

6. Common stock price reflects the value placed on a company by:

   (a) Banks (b) The government (c) The public (d) Management
   (e) Stock exchanges

7. A statement of a company's total assets cannot include:

   (a) Product inventory (b) Production machinery
   (c) Office buildings (d) Sales Income
   (e) Working capital

8. A company pays federal income taxes:

   (a) On funds left after paying dividends to stockholders (b) On sales income less operating expenses (c) On funds added to working capital (d) On funds remaining after plowback (e) None of the above.

9. The amount of dividends a company pays to its stockholders is determined by:

(a) Law (b) Management (c) Stock exchanges (d) Stockholders (e) Stock brokers

10. Sales of a company's products are likely to be influenced <u>least</u> by:

(a) Research and development (b) Common stock price (c) Product price (d) Advertising (e) Production capacity.

APPENDIX C

Situation Test

Last year the ABC Comapny was producing at 90% of capacity. Inventory levels were constant, and the company showed a profit. Market research showed that the total market potential for the company's product this year would be about the same as last year. The production department reported that they would be able to keep costs this year at the same level as last year.

This year the company's management decided to:

(1) raise the selling price of the company's product;
(2) increase production to 95% of capacity;
(3) spend less on marketing and advertising;
(4) spend less on product research and development;
(5) spend more on investment to reduce production costs.

On the basis of the information you have, do you think these were good decisions? Explain why or why not. Be as specific as you can.

Sample Answer for Situation Test

The ABC company has raised the price of its product and decreased its marketing and advertising. Both of these changes should result in lower sales. Yet the company has increased production at the same time. This combination of decisions would make sense only if the company's inventory levels had been falling drastically. But inventory levels had not been falling at all; they were constant.

Scoring Formula for Situation Test

1 point for mentioning each of the following relationships:

Lower marketing and advertising means less sales.

Higher price means less sales.

More production for less sales generally doesn't make sense.

Constant inventory rules out the possibility that the company was trying to avoid running out of product.